Retrofitting and Strengthening with Brass Coated Steel Fibre Concrete

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Abstract. The High performance concrete (HPC) study is to determine various types of material effects at a high temperature with content of Brass coated steel fibers (BCSF) effects on the workability, ductility enhancement of concrete. Various mixture of concrete was prepared and tested using various types and sizes of BCSF at the designed compressive strength of concrete of 80 to 100 MPa. The post-cracking tensile strength (>5 MPa). BCSF is HPC concrete for fire resistance, strengthening of existing structure and retrofitting. BCSF can improve the compressive strength of concrete, including tensile, and flexural strength, shear strength, crack resistance etc. Fire resistance is a compulsory design parameter that must be considered during selecting materials. The combination use of BCSF indicates that the residual engineering properties after being exposed to high temperatures is higher for concretes with the addition of steel fiber than the conventional concrete. The incorporation of BCSF into concrete is avoiding the occurrence of explosive spalling at high temperatures. Target temperature of concrete is around 600°C during fire [6]. The use of Brass coated steel fibre in concrete with GGBS is protective structures against fire and extreme loading conditions (e.g. high-velocity impact and blast), which is attributed to its advantages of higher tensile strength and better energy absorption capability compared to normal concrete. As per cube results it was concluded that the optimum percentage of steel fiber was 8% of total dry material and size 13 mm length used which has recorded the highest compressive strength at 28th days.

Keywords: Steel Brass Coated Fiber, GGBS, Fly Ash, Admixture, High Performance Concrete.

1. INTRODUCTION

In India as per IS 456:2000 the life of normal construction or structure is around 40 to 45 years. Existing R.C.C. structures during compressive test it observed that failed to sustain the designed load for a several different-different of reasons. This observe itself by poor performance under service loading due additional load, faulty design, lack of knowledge etc. in the form of larger deflections and cracking, or there has been not good enough ultimate strength.
It is impossible to prevent all major fires occurring in a structure (building), but fire risk can be mitigated through conscientious design and maintenance [1].

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Also, alteration and modification in structural design and loading codes may render many structures previously thought to be satisfactory or acceptable, non-compliant with current provisions. In the current economic climatic condition, rehabilitation of damaged concrete structures to meet the more stringent limits on serviceability and ultimate strength of the current codes, and strengthening of existing concrete structures to carry higher permissible loads, seem to be a more acceptable alternative solution to demolishing and rebuilding the structure which will save the cost of redevelopment [2, 3].

A dangerous, affected building might be older and maintained, be currently used for something it wasn't designed for heavy load and high temperature. Structural failure is when a structure or a component within it loses its capacity to carry a load. It happens when the material in a structure is stressed to the point of breaking or deforming too much. The main protective source is concrete which is protecting steel from the high temperature during the fire.

Brass-coated steel fibres are high-performance reinforcement materials which providing high strength to concrete largely used in various industries, especially in construction and composite manufacturing. These fibres are manufactured by high-tensile steel around 2750 to 3150 N/mm^2 and coated with a thin layer of brass (typically a copper-zinc alloy), which enhances their mechanical bonding and corrosion resistance properties which increase the life span of the concrete because of this the structure is durable and maintenance free for long period. The steel fibre has the composition of core which having high carbon content make a primary reinforcement to the fibre [4-7].

With the use of Brass coated fibre the concrete acts as High Performance Concrete which having the better heat absorption capacity around 600°C compare to normal concrete, because of its tensile strength. The normal concrete starts the failure during fire or at high temperature at 300°C [8].

Pozzolanic material like Ground Granulated Blast Furnace Slag (GGBS) which is waste product of iron production of steel factory which makes more cohesive to the concrete and continuously increasing the compressive strength of concrete for minimum 90 days from the concreting. Use of Steel fibre + OPC Cement + GGBS + Flyash + Admixture + Coarse and Fine Aggregates + Water. This make a High performance high strength concrete for durable and fire resistance structure High strength concrete is free flow concrete which can use for highly reinforced structure and where the vibration is not possible easily or no movement of labor is possible during the casting of concrete [9-12].

The GGBS can be replace OPC cement by 70 to 80%. It prevents the concrete from sulphate and chloride attack which will increase the durability of structure and saves the maintenance coast of the structures. The GGBS is finer and smoother than the cement, which results the cohesive concrete [13,14].

It is the replacement of cement which is contributing to reduce the carbon emission in the nature.

The result is better with the GGBS than the flyash. If GGBS is not available, then we can go with flashy with OPC cement. But the mix design will be revised on basis of flyash quality.

The use of GGBS gives the initial strengthening is slow but final strengthening is always better than other pozzolanic material. It controlling the heat of hydration during plastic stage so it helps to reduce and to prevent the shrinkage cracks etc.

The water cement ratio is in between 0.25 to 0.3 which gives always better compressive strength to the concrete.

The pH of water using for concreting should be between 6 to 8.5. The water should be pure and clean and free from harmful impurities like, oils, acids, alkalis, salts etc. which will affect the result of concrete.

The curing period should be follow for 10 to 14 days and should be prevent from heat of hydration. The curing admixture can be use to prevent curing but it was increasing the coast of concrete.

The brass coated steel fibre has tensile strength is 2750 N/mm2 to 3050 N/mm2 of diameter of 0.25 mm which is higher than the without coating steel fibre which having tensile strength is around 1450 N/mm2 of diameter of 0.75 mm fibre [15,16].

Many people are constrained to live in them due to various reasons like skyrocketing rise in real estate prices, fear of losing their houses after vacating for redevelopment projects. Repair and rehabilitation are significant for preserving the structure's capacity and increasing its performance capacity, which deteriorates due to aging factors, environmental factors. The recent collapse of the building named Tarique Garden in Mahad caused the deaths of 20 people. Considering this as a manufactured disaster, it made a national highlight seeking the attention of mainstream media. A sample space of buildings from buildings in khed city, about 200 km from Mumbai. [17].

2. LITERATURE REVIEW

The use of Brass Coated Steel Fibre reinforced concrete (BSFRC) with GGBS in protective structures against fire and extreme loading conditions (e.g. high-velocity impact and blast), which is attributed to its advantages of higher tensile strength and better energy absorption capability compared to normal concrete. The new technique using the CARDIFRCTM strip bonding system is a promising method for improving the flexural and shear behaviour, as well as the serviceability, of damaged concrete beams and other elements. The flexural strength and compressive strength of concrete is increasing by using Brass coated steel-reinforced which is Ultra High-Performance Concrete (UHPC) mixture are enhanced by increasing the weight fraction of embedded BCSF reinforcement with different shapes and sizes. Short-term creep increases with increasing stress levels and higher target temperatures, while it becomes constant when the succeeding stress level decreases at the same target temperature. The high-temperature compressive strength ratios and up to target temperature of 900°C. The result shows that short-term creep of RPC increases considerably above 500°Cand the increase under the same loading ratios at 700°C and 900°C is approximately 13 and 23 times as that of short-term creep at 120°C, respectively. Repair and Retrofitting with the advance material is sustainable and durable which having better strength compare to normal concrete.

3. OBJECTIVE

- Strengthening and Retrofitting - Due to increase of construction cost and environmental condition strengthening and retrofitting to existing structure is most suitable option in construction technology
- Fire resist structures - In petro-chemical industry fire resistance structure is most demandable.
- Save the rehabilitation cost - To built the new construction engineers have to save the rehabilitation construction cost of structure.

4. STATEMENT OF PROBLEMS

- Early stage deterioration of normal concrete due to high temperature and fire.
- Structure failure due to additional applied load by end users.
- Lack of knowledge of advance concrete technology.
- Poor performance under fire or extreme temperatures.
- Periodic maintenance of structure.

5. METHODOLOGY

- In this study, High strength Brass Coated Steel R/F concrete for repair and strengthening of structures.
- If the redevelopment of structure is more expensive then the strengthening, then using high strength concrete is the best solution.
- It can use for strengthening to the existing structure for the certain life period.
- To increase load bearing capacity of structure.
- Suitable for fire resist structure.
- Compressive and Tensile / flexural strength of concrete is greater than the conventional concrete.
- Material used to make high strength concrete is advanced.
- Removal of cover concrete.
- Treatment to the parent concrete. Treatment to the corroded steel reinforcement with supplement if required.
- Repair of cracks with suitable grouting materials.

- Building up of stable Micro–Concrete using with Brass coated steel fibre.
- Retrofitting to required structural elements.

5.1 Failures of Structure - Common Causes of Structural Failure:

Design Errors:

- Inadequate structural analysis or incorrect load calculations during designing.
- Use of inappropriate materials or construction methods due to lack of knowledge.

Poor Workmanship:

- Low-quality construction practices.
- Improper placement of reinforcement or joints.
- Improper concrete laying.

Material Defects:

- Substandard or defective construction materials (e.g., concrete, steel, admixture etc.)
- Corrosion of reinforcement, especially in aggressive environments.

Foundation Issues:

Uneven settlement, soil erosion Overloading:

- Loads exceeding the structure's design capacity (e.g., due to heavy load, equipment, snow, wind, or seismic activity).
- Weak soil bearing capacity.
- Inadequate or poorly designed foundations.

Environmental Effects:

- Corrosion, freeze-thaw cycles, or chemical attacks on concrete.
- Natural disasters / calamities like earthquakes, floods, or landslides.

Lack of Maintenance:

- Failure to inspect, repairs, or maintain structural components over time.

Fatigue or Wear:

- Repeated stress cycles leading to micro cracks and eventual failure.
- Common in bridges, pavements, and industrial structures, floors etc.

Types of Structural Failure:

- **Flexural failure** (bending cracks in beams or slabs)
- **Shear failure** (sudden diagonal cracks)
- **Buckling** (compression members like columns)

- **Torsional failure** (twisting under load)
- **Fatigue failure** (due to repeated stress cycles)
- **Tensile failure**: When a member is stretched beyond its strength, causing it to yield, neck, and then fail at its weakest point.
- **Compressive failure**: When a member is compressed or bent too much, causing it to break suddenly.
- **Buckling**: When a long, slender member is compressed, causing it to crumple and fail suddenly.
- **Fatigue failure**: When a structure is repeatedly loaded over time, causing cracks to develop and eventually lead to failure.

5.2 Failure due to Fire:

Loss of Strength:

- At temperatures above **300°C**, concrete begins to lose compressive strength.
- At **600°C and above**, significant deterioration occurs, potentially leading to collapse.

Spalling:

- Rapid heating causes moisture in concrete to vaporize, building up internal pressure.
- This leads to **explosive spalling**, where surface layer's peel or burst off suddenly.
- Spalling exposes the **reinforcement**, accelerating heat damage and reducing fire resistance.

Thermal Expansion and Cracking:

- Different components (aggregate, cement paste, reinforcement) expand at different temperatures.
- Causes **internal stress** and **cracking**, reducing load-bearing capacity.

Loss of Bond Between Concrete and Steel:

- Heat weakens the **bond strength** between concrete and embedded steel reinforcement.
- This reduces the composite action of the structure, leading to slippage or collapse.

Degradation of Cement Paste and Aggregates:

- Cement paste dehydrates at high temperatures, losing its binding properties.
- Some aggregates may expand or degrade, further reducing strength.
- The visible signs are the cracks that form after a fire has been doused or the discoloration of the cement. A continuous fire can result in spalling or crack-

down of the outer layer of cement or concrete. At around 300°C temperature, the RCC structure begins losing its load-bearing capacity.

- A continuous fire at 100–200°C can cause the outer layer of cement to crack or spall. A sustained fire at over 600°C can bring down concrete structures. According to study in construction loses around rupee's thousands of crores are losing in each year due to the fire in India.

5.3 Major Reasons of Fire:

- **Electrical issues**: Faulty electrical systems, malfunctioning circuit breakers, and electrical short circuits are leading causes of electrical fires.
- **Cooking**: Unattended cooking, grease build up, and flammable objects near heat sources can cause fires.
- **Smoking**: Careless smoking and improper disposal of cigarettes and cigars can ignite other materials.
- **Equipment and machinery**: Equipment malfunctions, such as in furnaces, boilers, and other heating equipment, can cause fires.
- **Combustible dust**: Combustible dust particles in the air can burn and cause small fires or explosions.
- **Flammable liquids**: Faulty storage, design, installation, maintenance, or use of plants and processes can lead to liquid leaks and dangerous vapours that can ignite.
- **Arson**: Arson is a major risk at construction sites due to the availability of ignition and fuel sources.
- **Children playing with fire**: Children playing with matchsticks and candles can cause fires.

5.4 Techniques used to prevent concrete at high temperature during fire:

- During construction concrete should be generally considered to be fireproof and has a high degree of fire resistance. It doesn't burn, doesn't emit toxic fumes, and can maintain its strength if it's kept cool or normal. However, concrete can experience several mechanical changes when exposed to fire, such as spalling and external cracking.
- Adding slag and coal – fired power plant ash to the paste alongside other chemicals, minerals and Brass coated steel fibre which is corrosion free and keeping cool to cement and concrete.
- Micro-Concrete is used for repair, retrofitting and strengthening to existing structures and R.C.C.

- Concrete for new Industrial and fire resist building are designed.
- **Use of Steel Fibres (Including Brass-Coated Steel Fibres)**
- Improve **toughness, ductility**, and **post-crack performance** at elevated temperatures.
- Help in **crack bridging**, slowing down the formation of large cracks during fire.
- Brass coating provides additional corrosion resistance and improved bond strength.

5.5 Audit of structure:

- A structural audit is a systematic technical assessment of an existing building or structure to evaluate its health, stability and safety during its intended life span.

1. Non-Destructive Testing: (NDT test)

- A method of evaluating materials, components or system for defects and quality without causing any damage or alteration to the elements being tested.

Ultrasonic Pulse Velocity Test:

- The Ultrasonic Pulse Velocity (UPV) test uses the speed of sound waves to non-destructively assess concrete quality, detect cracks and voids, estimate strength, and monitor structural changes over time. It involves generating ultrasonic pulses and measuring the traveling time through a concrete specimen to calculate the velocity. This velocity is then correlated to concrete quality, with higher velocities indicating better quality and integrity.

Rebound Hammer Test:

- The rebound hammer test is a non-destructive method used to assess the surface hardness and estimate the in-place strength of concrete. It involves striking a spring-loaded mass against the surface, and the extent of its rebound, or rebound number, is measured and correlated to the material's strength. This test provides a quick, preliminary quality check for structures and is valuable for comparing strength across different parts of a structure, though it is not a substitute for laboratory compressive strength tests.

Half Cell Potentiometer Test:

- A half-cell potential (HCP) test is a non-destructive method to assess the corrosion risk of reinforcement in concrete structures by calculating the electrical potential variation between the steel and a reference electrode on the concrete surface. The test involves placing a copper-copper sulphate reference electrode on a moist concrete surface and connecting it to a highimpedance voltmeter, with the other terminal of the voltmeter connected to the reinforcing steel. Readings are taken across a grid of points on the surface, with lower (more negative) potential values indicating a higher probability of corrosion.

Carbonation Test:

- A carbonation test measures the depth to which atmospheric carbon dioxide (CO2) has penetrated and reacted with concrete, which lowers the concrete's pH level. The test is performed by spraying phenolphthalein solution onto a freshly exposed concrete surface: a colourless result indicates carbonation, while a purple colour indicates uncarbonated concrete. This test is important because it assesses the risk of corrosion to the steel reinforcement within the concrete.

2. Destructive Test:

Destructive tests for concrete involve applying loads to the material until it fails, providing precise measurements of its strength and durability. Common methods include the compressive strength test, where a cube is crushed to find the force required for failure; the split tensile test, which measures the concrete's ability to resist being pulled apart; and the flexural strength test, used for structural elements applications as beams, column etc. These tests are most important for required quality control during construction and for evaluating the integrity of existing structures.

Core Cutting:

- A core test of concrete involves drilling cylindrical core samples from an existing structure to assess its hardened compressive strength and quality. This destructive test is used to evaluate a structure's structural integrity, verify the concrete's compliance with design specifications, and investigate distress. The test helps determine if the concrete meets required strength standards, and from the test results can also get information about internal defects, concrete deterioration, corrosion, or presence of chloride content.

Table 1. Mix Design of concrete.

Mix Design As per IS 456:2000 & IS 10262:2009							
SR. No.	**Material**	**Quantity in Kg**					
	28 Days Compressive Strength in Mpa	**112.08**	**99.99**	**95.11**	**91.54**	**86.05**	**77.32**
	Mix Design Samples	1	2	3	4	5	6

1	OPC Cement	32	30	30	28	28	24
2	Fly Ash	5	5	6.5	6	6.5	6
3	GGBS	6	8	6.5	6	6.5	6
4	Silica Sand 30 Mesh/600 Microns	16	16	16	17	17	0
5	Silica Sand 16 Mesh/1.18 MM	32	32	32	34	34	0
6	VSI Sand	0	0	0	0	0	50
7	Aggregate 10 MM	0	0	0	0	0	6
8	Aggregate 20 MM	0	0	0	0	0	8
9	Admixture	9.5	9.5	9.5	9.5	8	6
10	Brass Coated Steel fibre	8	8	8	7	6	4
11	Water	9.5	9.2	9.3	10.5	11	11.5

Table 1, Shows the material used for the cube casting and trail for the concrete and achieved the desired compressive strength with respect to the used materials. The coarse and fine materials are taken from the local and nearest source and other material arranged from different – different sources.

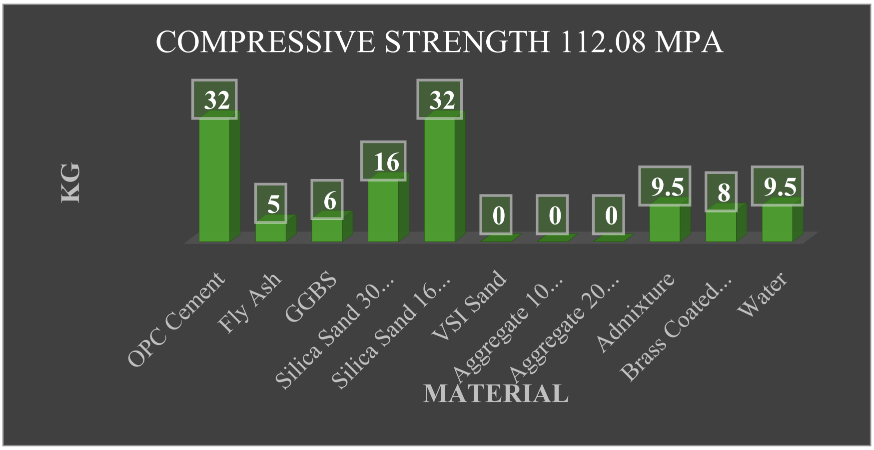

Fig. 1 Graph of compressive strength of concrete without coarse particles.

Fig. 1, Shows highest compressive strength of concrete i.e., 112.08 MPA with micro silica sand and without coarse aggregates.

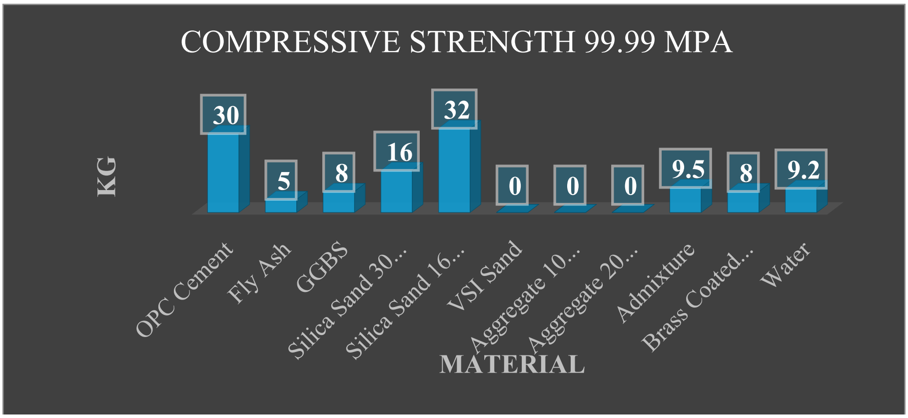

Fig. 2 Graph of compressive strength without coarse particles.

Fig. 2, Shows compressive strength of concrete i.e., 99.99 MPA with micro silica sand and without coarse aggregates with reducing cementitious content compare to figure 1.

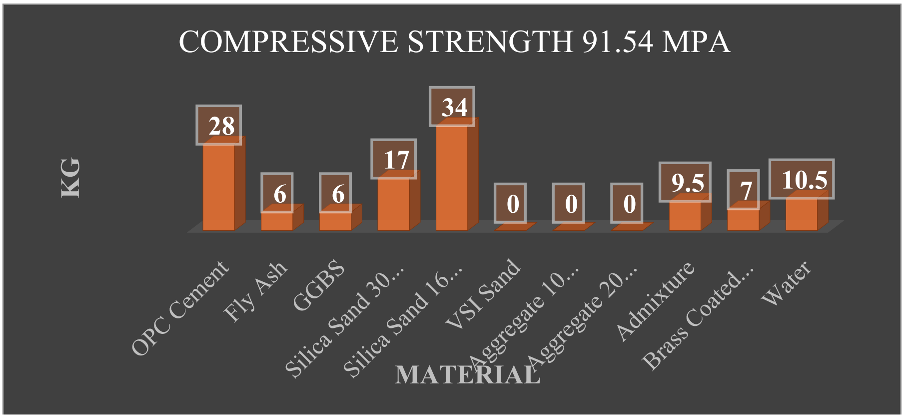

Fig. 3, Graph of compressive strength with Silica Sand.

Fig. 3, Shows compressive strength of concrete i.e., 91.54 MPA with micro silica sand and without coarse aggregates with reducing cementitious content compare to figure 2.

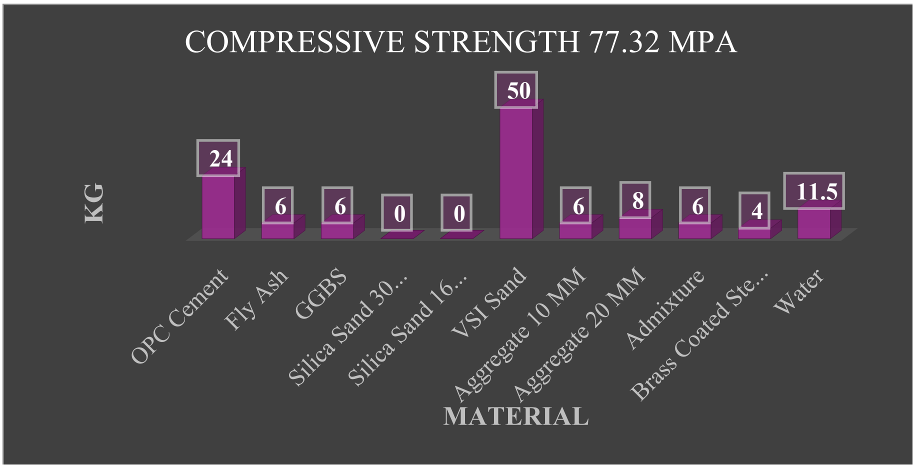

Fig. 4 Graph of compressive strength with coarse particles of 28 days.

Fig. 4, Shows compressive strength of concrete i.e., 77.32 MPA without micro silica sand and with coarse aggregates with reducing cementitious content compare to figure 4 which is lowest compressive strength of tested results.

Fig. 5 60 minute's slump flow 610 MM.

Fig. 5, Shows designed concrete slump of workable concrete for 60 minute i.e., 610 MM.

Fig. 6 120 minute's slump flow 220 MM.

Fig. 6, Shows designed concrete slump of workable concrete for 120 minute i.e., 220 MM.

Fig. 7 Beam and Cube casting for compressive strength testing.

Fig. 7, Shows beam casting with the fresh concrete for flexural test of 28 days.

Fig. 8 Concrete cube casted for compressive strength testing for 3, 28 & 56 day.

Fig. 8, Shows cube and beam casted for compressive and flexural test of 28 days.

Figure 9 Flexural Beam Test.

Fig. 9, Shows flexural testing at the laboratory of 28 days with using brass coated steel fibre.

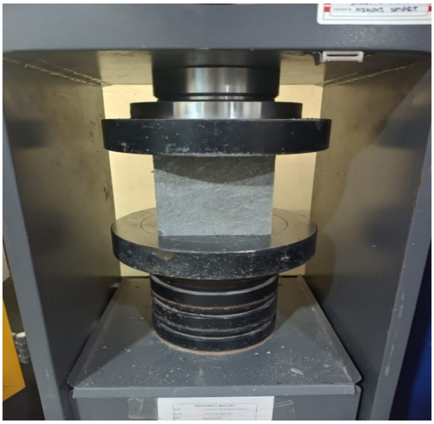

Fig. 10 Compressive strength testing on CTM for 28 & 56 day.

Fig. 10, Shows compressive testing at the laboratory of 28 days and 56 days with using brass coated steel fibre.

Fig. 11 Furnace 1450°C for high temperature cube testing.

Fig. 11, Shows temperature testing at the laboratory of 28 days and 56 days with using brass coated steel fibre for the 650°C.

Fig. 12 Crack on cube after heating at 650°C.

Fig. 12, Shows cracks and deformation on cube after the temperature testing at the laboratory of 28 days and 56 days with using brass coated steel fibre for the 650°C.

6. PESO PROJECT

Fig. 13 Petroleum and Explosive safety organisation (PESO) approved fire resist running project view.

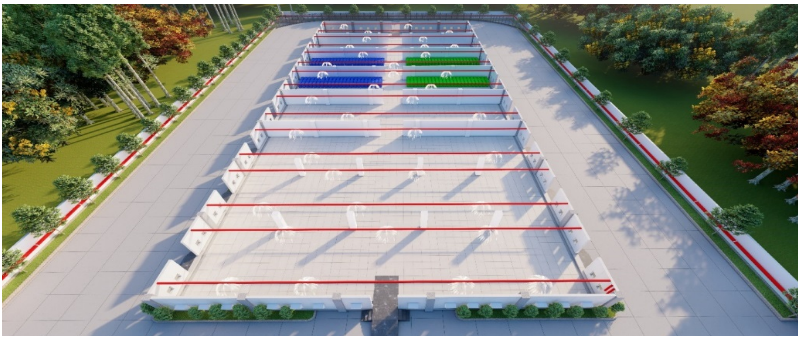

Fig. 14 PESO approved fire resist internal view of structure.

Fig. 13 and **14,** are the view of the PESO running project and all above methods and my knowledge with experimental work done here which is I'm using and providing to the client at the Petroleum storage warehouse for the petroleum chemical storage which is highly explosive where we doing the structure as fire resist and flooring is with high performance concrete.

To prevent any fire accident providing underground water tank with storage capacity of 9 lack liter for firefighting system which is minimum 2 hour's water supply period for 30,000 sqft. area at a time.

Outer wall and internal partition will use AAC block with high strength ready-mix plaster.

The concrete behaviour should be as cold concrete and for that performance using GGBS with OPC.

The structure elements are design to sustain fire for minimum 2 hours. The roof is covering with Asbestos sheets which is good fire resistance material. It also usable during fire if the tin drum blast than the drum can hit due to high pressure and it break the asbestos sheet and get outside which the PESO norms we here following.

The project is under category Petroleum Class A

Flash Point below 23°C

Material Storage for gasoline, acetone etc.

Under class A fluid is highly volatile, flammable and explosive.

The project is under the Petroleum and Explosives Safety Organisation (PESO)

The project work is under the construction.

7. RESULTS

Table 2. Test Report.

Test Reports					
As per IS - 4031 part-6 (Cube Dimension 150 * 150 * 150 MM)					
Cube Ref. Number	**Cast Date**	**Date of Test**	**Date of Test**	**Compressive Strength**	**Compressive Strength**
		DAYS	DAYS	7 DAYS	28 DAYS
		7	28	N/sq.mm	N/sq.mm
1	05-08-24	12-08-24	02-09-24	64.5	77.32
2	17-08-24	24-08-24	14-09-24	60.76	81.07
3	28-08-24	04-09-24	25-09-24	71.52	82.1
4	15-09-24	22-09-24	13-10-24	67	82.66
5	26-09-24	03-10-24	24-10-24	73.28	85.34
6	10-10-24	17-10-24	07-11-24	72.49	86.05
7	20-10-24	25-07-49	17-11-24	74.75	91.54
8	05-11-24	12-11-24	03-12-24	81.77	95.11
9	10-11-24	17-11-24	08-12-24	89.62	99.99
10	20-11-24	27-11-24	18-12-24	104.54	112.08

Table 2, Shows the test result of work done during the project work which shows 7 and 28 day's compressive strength of concrete. The highest compressive strength is for cube ref. no. 10 which 104.54 N/mm^2 for 7 days and 112.08 N/mm^2 for 28 days which is highest compressive strength of the project work. The test result shows that the using advance material with brass coated steel fibre concrete results better higher strength than the normal concrete which can use as fire resistance structure.

Fig. 15 Brass Coated Steel fibre of Diameter Avg. 0.3 mm.

Fig. 15, Shows the brass coated steel fibre is used for high strength concrete which have good fire resistance capacity. It is generally used for Industrial, fire-resistant buildings construction, road pavement etc. It has the tensile strength is around 2750 to 3050 Mpa. This fibres are using were the tensile strength of fibre required more than 2800 N/mm^2. It is costly than the steel fibre and price is around 200/- per kg

L= length of steel fibre = 13mm

D= diameter of steel fibre = 0.3mm

Aspect ratio = l/d = 13/0.3 = 42 kg per cubic meter

But it can use from 30 to 40 kg per cubic meter in concrete.

PURUSHOTTAM STEEL WOOL PVT LTD

Ground Floor Plot No. 83 Ram Krishna Nagar Opp Union Bank of India
Rana Pratap Nagar Nagpur – 440022
PHONE-9503045001,9370655855
GST NO- 27AAPCP1345K1Z1

TEST CERTIFICATE FOR BRASS COATED STEEL FIBER

Size: 0.25/13.00 **Date: 20/09/25**

TEST	SPECIFICATION NO. ASTM A-820 TYPE-I	OUR ANALYSIS	REMARKS
CHEMISTRY:			
Carbon	1.00% Max	0.71%	
Silicon	0.30% Max	0.20%	
Manganese	1.20% Max	0.53%	
Sulphur	0.03% Max	0.005%	
Phosphorous	0.03% Max	0.021%	
Diameter of Fiber	0.25mm	+/- 2%	
Length of Fiber	13.00mm	+/- 5%	
Surface of Fiber	Brass Coated	Brass Coated	
TENSILE STRENGTH OF WIRE	2750 – 3050 Mpa	2867, 2786, 2984	

Fig. 16 Brass Coated steel fibre test certificate.

Fig. 16, Shows the test reports and contents of brass coated steel fibre.

Fig. 17 Steel Hook fibre of Diameter 1 mm.

Fig. 17, Shows without brass coated fibres which are using were the tensile strength of fibre required equal to 1450 N/mm^2. It is cheaper than the brass coated steel fibre and price is around 85/- per kg.

L= length of steel fibre = 30mm

D= diameter of steel fibre = 1mm

Aspect ratio = l/d = 30/1 = 30 kg per cubic meter

We can use from 15kg per cubic meter after trail.

Fig. 18 Polyvinyl Chloride fibre.

Fig. 18, Polyvinyl chloride fibre is generally using for normal construction like residential building, water tank etc. It required around 0.9 kg for per cubic meter concrete. It is cheaper than brass coated steel fibre and non-coated steel fibre. It is around 150/- per kg.

Fig. 19 Material used for high strength concrete.

Fig. 19, Shows the material used for the mix design is Ordinary Portland Cement (OPC) + Fly ash + GGBS / Slag + Admixture + Brass Coated Fibre + Quartz Sand + Fine Aggregate + Coarse Aggregate.

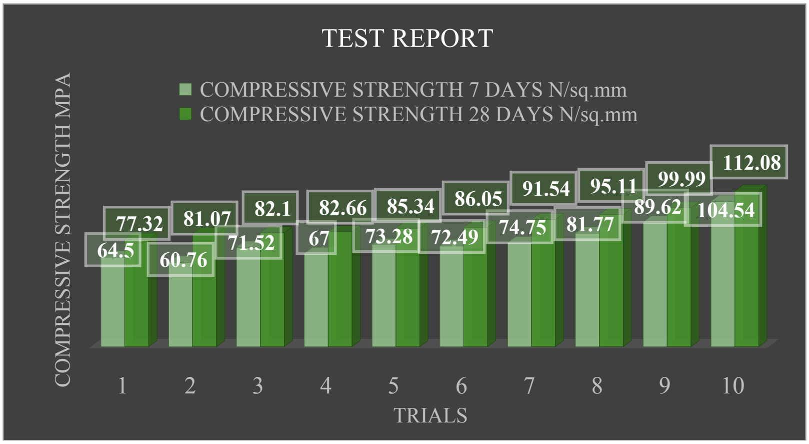

Fig. 20 Graphical representation of test report of 7 and 28 days.

Fig. 20, Shows the graphical representation of compressive strength of 7 and 28 days. The range of compressive strength is in between 64.5 MPA to 112.08 MPA.

8. CONCLUSION

i. All of above test result its conclude that using the concrete with BCSF is having compressive and flexural strength is greater than normal fibre concrete.

ii. It can resist high temperature around 600°C which twice than normal concrete.

iii. The BCSF concrete having greater life period than the normal concert and good capacity to sustain the load.

iv. Micro-Concrete with BCSF is suitable for strengthening and retrofitting to the existing structure.

v. The replacement of cement with GGBS which contribute to reduce carbo emission in the nature.

vi. It can save the cost of project compare to demolish the structure and to build new RCC structure with the target strength.

vii. The structure can sustain better in high temperature easily than normal concrete during the fire, the concrete has good heat absorbing capacity.

viii. As per results the concrete with BCSF is maintenance free for industrial floor and road pavement for long life which will save the maintenance cost of project.

9. FUTURE SCOPE

I. The use of Brass coated steel fibre reinforcement for construction is to make cost effective and easy to available.

II. Fire rating test.

REFRENCES

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